METHODS AND APPARATUS FOR SUSPENDING FIXTURES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to mechanical fasteners. More particularly, the invention relates to mechanical fasteners suitable for suspending fixtures such as acoustic tile ceilings, pipes, lighting fixtures, electrical cables, HVAC equipment etc.

2. State of the Art

Current practice in the construction trade and building industry is to suspend fixtures with wires which are fastened to a wall or ceiling. An example of a state of the art apparatus for suspending fixtures is illustrated in prior art Figure 1. The apparatus generally includes an angle bracket 10 having two holes 12, 14, a fastener 16 (typically a nail or a screw), and a length of wire 18 (often six to eight feet long). The method for using the apparatus includes attaching the wire 18 through one of the holes 14, inserting the fastener 16 through the other hole 12, and fastening the fastener 16 to a wall or ceiling 20. An exemplary bracket and fastener are illustrated in U.S. Patents Number 5,178,503 and Number 4,736,923.

The apparatus shown in Figure 1 is often used to suspend fixtures from cement, stone, or other masonry material ceilings, typically in commercial buildings. The wires 18 are attached to ceiling tile grids, pipe brackets, HVAC ducts, lighting fixtures, etc. Because a relatively large variety of equipment is hidden above a suspended acoustic tile ceiling in a commercial building, the wires 18 are often six to eight feet long.

The fastener 16 is usually pre-fit into the hole 12 of the bracket 10 during manufacture. However, the wire 18 (usually 12 gauge galvanized steel) must be manually attached to the bracket 10 by inserting a free end of the wire through the hole 14, looping the wire onto itself and twisting it as shown in Figure 1. This is often done by hand with a pair of pliers or may be done with the aid of a hand operated (or drill operated) crank such as the "wire tying fixture", item number 00052075, sold by Hilti, Inc., Tulsa, Oklahoma. These methods of attaching the wire to the bracket present several disadvantages.

The most apparent disadvantage is the cost of labor for the labor intensive task of twisting the wire. In order to be reasonably secure and satisfy some municipal codes, approximately eight inches of the wire must be twisted eight to ten turns about itself. In practice, many workers only twist the wire three or four times about itself. Still, the work is time consuming. The

best productivity is not much more than about 300 pieces per hour and after about 500 pieces the worker needs to rest.

Another disadvantage is that this method of connecting the wire to the bracket is not very secure. Under a stress of about 50 lbs., the wire loop stretches and under a stress of about 210 lbs. the wire untwists.

Still another disadvantage is that the connection between the wire and the bracket is loose. Under normal circumstances, gravity provides tension between the wire and the bracket. However, in the case of an earthquake or a fire, the loose connection between the wire and the bracket allows vibration and movement of the fixtures supported by the wire. This can result in fixtures falling onto emergency workers and other similar hazards.

SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide improved methods and apparatus for suspending fixtures.

It is also an object of the invention to provide methods and apparatus for suspending fixtures which are not labor intensive.

It is another object of the invention to provide methods and apparatus for suspending fixtures which are more economical than the state of the art.

It is still another object of the invention to provide methods and apparatus for suspending fixtures which are safer and stronger than the state of the art.

In accord with these objects which will be discussed in detail below, the apparatus of the present invention includes an angle bracket with a hole for a fastener and a flange for coupling a wire to the angle bracket. The flange is lanced and it is coupled to the wire by crimping. According to a first embodiment of the invention, the flange is provided with two horizontal lances. According to a second embodiment, the flange is provided with at least three alternating horizontal lances. According to a third embodiment, the flange is provided with a horizontal lance and a vertical lance. According to a fourth embodiment, the flange is provided with a vertical lance in the shape of a hook and an eyelet is provided for connecting the wire. According to a fifth embodiment, the flange is wrapped to form a slotted cylinder. The wire is inserted into the slotted cylinder which is then compressed and crimped onto the wire. According to a sixth embodiment, the angle bracket is provided with two wire connecting

flanges. A seventh embodiment is similar to the sixth embodiment with features of the second embodiment.

A kit according to the invention includes a plurality of lanced angle brackets, a plurality of pre-cut lengths of wire, and a combined crimping and testing tool.

The apparatus of the invention is stronger than the state of the art apparatus. Wire crimped to the bracket does not begin to stretch until a stress of approximately 420 lbs. is applied. This is about twice as strong as the looped wire and bracket combination of the prior art. According to the preferred embodiments, only about 3/4" of wire is crimped to the bracket. Thus, almost eight inches of wire is saved in each assembly. Using the crimping tool of the invention, a worker can produce 2,000 wire-bracket assemblies per hour, nearly seven times the productivity of the prior art method. In addition, the methods and apparatus of the invention produce consistent results and do not rely on the integrity of the assembly worker to perform the required number of twists. Furthermore, the connection between the bracket and the wire according to the invention is a rigid connection which enhances the safety of the apparatus.

Additional objects and advantages of the invention will become apparent to those skilled in the art upon reference to the

detailed description taken in conjunction with the provided figures.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic side elevational view, in partial section, of a state of the art apparatus for suspending fixtures;

Figure 2 is a side sectional view of a first embodiment of a bracket according to the invention;

Figure 3 is a side elevational view of the bracket of Figure 2;

Figure 4 is a bottom plan view of the bracket of Figures 2 and 3;

Figure 5 is a side sectional view of the bracket of Figures 2-4 with a wire attached to it;

Figure 6 is a view similar to Figure 5 of a second embodiment of a bracket according to the invention with a wire inserted but prior to crimping;

Figure 7 is a side sectional view of a third embodiment of a bracket according to the invention with a wire inserted but prior to crimping;

Figure 8 is a side sectional view of a fourth embodiment of a bracket according to the invention;

Figure 9 is a side elevational view of a wire with an eyelet for use with the fourth embodiment of the bracket of the invention;

Figure 10 is a side elevational view in partial section of a fifth embodiment of a bracket according to the invention;

Figure 11 is a bottom view of the fifth embodiment;

Figure 12 is a side elevational view in partial section of a sixth embodiment of a bracket according to the invention;

Figure 13 is a view similar to Figure 12 of a seventh embodiment of the invention;

Figure 14 is a top view of the seventh embodiment;

Figure 15 is a view in the direction 15-15 of Figure 14; and

Figure 16 is a schematic side elevational view of a crimping and testing apparatus according to the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to Figures 2-4, a first embodiment of the invention includes an angle bracket 100 having a first flange 102 and a second flange 104. The first flange 102 is provided with a hole 106 for receiving a fastener such as a nail (not shown). The second flange 104 is lanced in two places to provide loops 108, 110 which are dimensioned to receive an appropriate wire.

It is intended that the words lance, lanced, and lances be read broadly enough to include any procedure which results in the described structure. Thus, it may be possible, for example, to cast the angle bracket in a single operation which results in the described structure.

Figure 5 illustrates the first embodiment 100 with a wire 112 inserted into the loops 108, 110 and the loops crimped tight against the wire.

It will be appreciated that the method of using the apparatus of the invention includes inserting the end of the wire through the loops, crimping the loops, inserting a fastener through the

hole, fastening the bracket to a surface with the fastener, attaching the other end of the wire to a fixture.

Figure 6 illustrates a second embodiment of the invention. The second embodiment includes an angle bracket 200 having a first flange 202 and a second flange 204. The first flange 202 is provided with a hole 206 for receiving a fastener such as a nail 207. The second flange 204 is lanced in at least three places to provide loops 208, 209, 210, 211, and 213. The loops are alternated in opposite directions. Figure 6 shows a wire 212 inserted through the loops. It will be appreciated that in this embodiment, because of the alternating loops, the flange 204 stops the wire 212 from passing beyond the upper loop 208.

Turning now to Figure 7, a third embodiment of the invention includes an angle bracket 300 having a first flange 302 and a second flange 304. The first flange 302 is provided with a hole 306 for receiving a fastener (not shown). The second flange 304 is lanced in two places to form a tongue 308 and a loop 310. The tongue 308 is provided with a hole 309 which is dimensioned to receive a wire 312. According to this embodiment, the end of the wire 312 is bent approximately 180° and inserted into the hole 309 and the loop 310. The tongue 308 and the loop 310 are then crimped against the wire 312. It will be appreciated that the

tongue 308 and the loop 310 can be crimped against the wire before the wire 312 is bent.

Figures 8 and 9 illustrate a fourth embodiment of the invention. The fourth embodiment includes an angle bracket 400 having a first flange 402 and a second flange 404. The first flange 402 is provided with a hole 406 for receiving a fastener (not shown). The second flange 404 is lanced to form a hook structure 408. As shown in Figure 9, a wire is coupled to an eyelet 414 by crimping. According to this embodiment of the invention, the eyelet 414 is coupled to the hook 408 and the hook 408 is preferably crimped over the eyelet 414. Those skilled in the art will appreciate that this embodiment could be used with the looped prior art wire 18 shown in Figure 1. Such a combination would obtain some of the advantages (strength and physical integrity) of the invention but not the other advantages (e.g. ease of use, economy of labor, etc.).

Figures 10 and 11 illustrate a fifth embodiment of the invention. The fifth embodiment includes an angle bracket 500 having a first flange 502 and a second flange 504. The first flange 502 is provided with a hole 506 for receiving a fastener such as a masonry nail 507. As illustrated in Figure 10, structure is provided to secure the nail to the hole so that the

bracket 500 can be easily located by an installer using one hand and the nail driven with a tool using the other hand.

The second flange 504 is rolled from two sides 508, 510 to form a slotted cylinder for receiving a wire 512. After a wire 512 is inserted into the cylinder, it is compressed and crimped, e.g. as shown at 513 and 515.

It will be appreciated that the fifth embodiment shows an angle bracket having an approximately 45° angle whereas the previous embodiments illustrated an approximately 90° angle. Those skilled in the art will appreciate that in some applications a 45° angle is preferred over a 90° angle. For example, if a fixture is mounted at opposite sides with 45° angle brackets, the resulting structure will be resistant to lateral movement which might otherwise be caused during an earthquake, for example.

Figure 12 illustrates a sixth embodiment of the invention which is similar to the fifth embodiment. Similar features of this embodiment are referenced with similar (increased by 100) reference numerals. According to the sixth embodiment a third flange 604b is provided on an opposite side of the first flange 602 directly opposed from the second flange 604a. This permits two wires 612a, 612b to be coupled to the angle bracket 600.

According to the invention, it is also possible to provide the angle bracket with additional flanges for coupling three or four or even more wires depending on the configuration of the first flange. For example, the first flange could be shaped as any polygon, thereby determining the maximum number of wire coupling flanges.

Those skilled in the art will appreciate that the masonry nails 607 of the type used in prior art apparatus for suspending fixtures can support more than one thousand pounds. Thus, when suspending a plurality of relatively lightweight fixtures, significant labor reduction can be achieves by using appropriately positioned angle brackets with multiple wires coupled to each bracket.

Figures 13-15 illustrate a seventh embodiment of the invention which combines features of the sixth and second embodiment. The reference numerals in Figures 13-15 are similar (in their last two digits) to the reference numerals used in Figures 6 and 12 and correspond to similar features as those referenced in Figures 6 and 12.

A kit according to the invention includes a plurality of lanced angle brackets, a plurality of pre-cut lengths of wire, and

a combined crimping and testing tool. Figure 13 illustrates a crimping and testing tool 700.

Turning now to Figure 13, the tool 800 includes a lever 802 coupled by a pivot 804 on a pivot arm 805 which is coupled to a base 815. A spring 806 on one side of the pivot arm 805 holds the lever 802 in a raised position. The lever 802 is provided with a crimping hammer 808 and a crimping anvil 810 is located below the hammer 808. It will be appreciated that by placing the second flange of one of the angle brackets of the invention onto the anvil 810, and pressing down on the lever 802, the hammer 808 will form the crimps described above.

The tool 800 also preferably includes a tension spring 812 coupled to the base 815, a first mounting 814 coupled to the spring 812, and a second mounting 816 coupled to the lever 802. The mountings are adapted to couple with an angle bracket and a wire attached to the angle bracket. when an angle bracket and wire are coupled to the mountings and the lever is pressed down, the integrity of the coupling between the bracket and the wire will be stressed. The spring 812 preferably has a spring constant which will stress the bracket-wire coupling sufficiently to insure that the coupling will support the desired load.

According to the presently preferred embodiment, the lever 802 has two telescoping parts 807, 809 so that its length can be adjusted. A pin 803 and a plurality of holes 813a-913c lock the telescoping parts in a selected length. A soft hand grip is preferably provided at the end of the lever 802. The base 815 is preferably provided with wire guides 811, 813 to stabilize the wire during crimping. According to the presently preferred embodiment, the spring 812 is selected to provide a stress of approximately two hundred pounds to the crimp when the lever is pressed down.

The apparatus of the invention is stronger than the state of the art apparatus. Wire crimped to the bracket does not begin to stretch until a stress of approximately 420 lbs. is applied. This is about twice as strong as the looped wire and bracket combination of the prior art. According to the preferred embodiments, only about 3/4" of wire is crimped to the bracket. Thus, almost eight inches of wire is saved in each assembly. Using the crimping tool of the invention, a worker can produce 2,000 wire-bracket assemblies per hour, nearly seven times the productivity of the prior art method. In addition, the methods and apparatus of the invention produce consistent results and do not rely on the integrity of the assembly worker to perform the required number of twists. Furthermore, the connection between

the bracket and the wire according to the invention is a rigid connection which enhances the safety of the apparatus.

There have been described and illustrated herein several embodiments of methods and apparatus for suspending fixtures. While particular embodiments of the invention have been described, it is not intended that the invention be limited thereto, as it is intended that the invention be as broad in scope as the art will allow and that the specification be read likewise. It will therefore be appreciated by those skilled in the art that yet other modifications could be made to the provided invention without deviating from its spirit and scope as so claimed.